

# ***Stabilizing highly erodible sites in the Guánica Watershed: Implementation and capacity building***

## **FINAL REPORT**



### ***Submitted to:***

**Lisa Vandiver, Ph.D.**

Marine Habitat Restoration Specialist  
Earth Resources Technology Contractor

### **NOAA Restoration Center**

2234 South Hobson Avenue  
Charleston, SC 29405

**Anne Kitchell, LEED AP**

Sr. Environmental Planner

### **Horsley Witten Group**

90 Route 6A, Sandwich, MA 02563  
*Sustainable Environmental Solutions*



### ***Submitted By:***

**Roberto A. Viqueira Ríos**

Executive Director

### **Protectores de Cuencas, Inc.**

Box 1563 Yauco Puerto Rico 00698

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***Protectores de Cuencas, Inc.***

Box 1563 Yauco  
Puerto Rico, 00698  
Tel. 787-457-8803

[rviqueira@protectoresdecuencasinc.org](mailto:rviqueira@protectoresdecuencasinc.org)  
[www.protectoresdecuencas.org](http://www.protectoresdecuencas.org)



# 1 SUMMARY

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Watersheds in Puerto Rico are in need of erosion control and sediment stabilization techniques of erodible lands. These techniques can help minimize the amount of sediments and other pollutants entering the freshwater systems and eventually reaching the coastal ecosystems. Protectores de Cuencas (PDC) has defined a set of methods to stabilize bare soils on high mountain and dry coastal sites in Puerto Rico. These methods are applicable to other sites across the Caribbean and likely into the tropical areas of the Pacific.

In our efforts to support and implement the Guanica Watershed Management Plan, we are collaborating with other agencies to continue with the restoration efforts of the Guanica Bay Watershed. Hydroseeding has proven to be an effective technique for erosion control and sediments stabilization of erodible lands. PDC has recently worked with two farms located within the Guanica watershed to implement this efficient technique (Figure 1). This effort continues to develop on the more than 24.5 acres of bare soils that have been stabilized by hydroseeding across the Guánica/Río Loco watershed with the ongoing funding support of the NOAA's Restoration Center and with the local support of Municipalities and Environmental agencies.

The Maria Antonia Farm, located in the Guánica valley, is in close proximity to Río Loco, part of the Guanica watershed. A total of approximately 3.5 acres were restored in this farm. The National Resource Conservation Service (NRCS) had previously implemented a project identified in the Guanica Bay/Río Loco Watershed Management Plan. PDC and NRCS partnered to increase the restoration efforts and we implemented the hydroseeding

component. The NRCS Southwest Conservation District (SWCD) was a collaborator as they provided seeds of Bermuda grass as part of the in-kind/match contribution, as well as part of the irrigation efforts. Furthermore, local farmers collaborated by providing water for irrigation upon completion of the hydroseeding application.

The second farm selected, located in the Yauco coffee farming area, is in its developing stages and suffering severe erosion problems. Farm owners were eager to stabilize portions of their soils in order to continue farm development using proper erosion control and sedimentation stabilization techniques. As it has been challenging to convince farmers to use grass as vegetative cover on their farms, the selected farm is in the center of the most active coffee farming area of the watershed. The selection of this farm was intended for it to serve as a model for other area farmers and served as an incentive for them to implement these conservation measures in other farms.



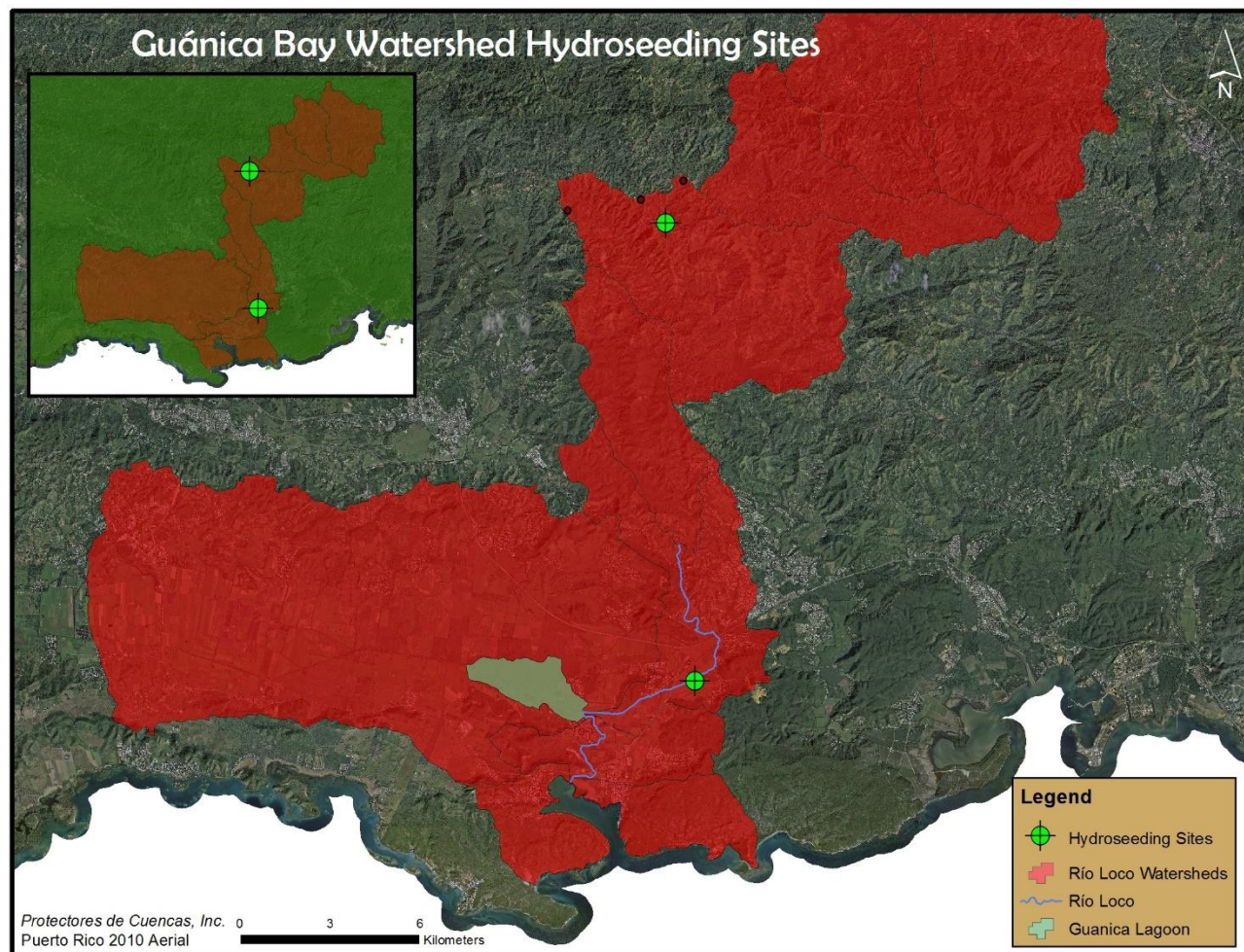


Figure 1. Guanica Bay watershed hydroseeding site locations.

## 2 INTRODUCTION

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Hydroseeding refers to a process of planting grass using a mulch mixture that is fast, efficient and an economic alternative to restore areas of high slopes with difficult access when compared to other techniques such as turf grass. This process has proven to be more effective than traditional sowing and with lower costs than conventional transplantation. A mulch mixture composed of fibers, seeds, fertilizer and water is added to the tank of the machine. Once the appropriate mulch mixture is achieved, the mixture is pumped from the tank and applied on the soil. Once the materials come in contact with the soil, they easily adhere and create favorable conditions for seed germination.

The hydroseeding method is mostly used to restore areas devoid of vegetation affected by erosion processes and sedimentation in order to protect bodies of water and marine ecosystems from the adverse effects of sediment laden runoff. Other common uses of hydroseeding include: at construction sites, cover crops for farm lands, revegetate green areas after road construction, residential and commercial landscaping, as well as extensive areas such as golf courses and stadiums.

A large amount of mulch options are available, from the most inexpensive (composed of 100% recycled paper or a mixture of 50% recycled paper and 50% wood fiber), intermediate costs (composed of 100% wood fiber), and the most costly, the Bounded Fiber Matrix or BFM (composed of 100% wood fiber with added polymers and other additives that maximize its attachment to the soil). Typically, the mixture chosen depends on the degree of the slope, the available budget and the quality of the desired product.

Studies by the University of North Carolina in the United States have shown that the mulch mixture composed of paper fibers results in low quality and poor germination rates. It is for this reason that we have decided not to use paper fiber mixtures for our hydroseeding projects. We've had excellent results using mixtures of 100% wood fiber with the addition of some products found in the BFM, allowing us to reach optimum results with an intermediate budget.

There are different types of machinery or hydromulchers on the market. The main difference between these different options is the size of the machine and its tank capacity. In order to work with wood based mixtures, a specialized machine with greater power is needed. Protectores de Cuencas, Inc. has one of these specialized machines for wood based mixtures, with a water storage capacity of 325 gallons, making it the perfect combination of power and size adequate to reach areas that would be impossible to reach with larger equipment. With this equipment we can cover an area between 1,200 and 1,500 ft<sup>2</sup> per tank applying close to 6 tanks daily in order to cover one acre of land between 4 and 7 days, depending on the slope angle and accessibility to the area.

Regular irrigation of restored areas during the first four to six weeks after hydroseeding is necessary in order to obtain optimum results. We include this service in our projects to guarantee best results. Application should occur during dry periods, where heavy rain is not anticipated during 48 to 72 hours following application in order to allow product fixation to the soil.

## 3 IMPLEMENTATION

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### 3.1 Maria Antonia Farm

Maria Antonia Farm, is located in the Guanica Valley bordering the Rio Loco to the south (Figure 2). Maria Antonia Farm is administrated by the Puerto Rico Land Authority and rented by a various farmers. One of the most relevant recommendations of the Guánica WSMP was to restore and stabilize the riverbanks of the Rio Loco. The riverbanks are eroding at an increasingly accelerated rate due to the presence of old irrigation infrastructure in the river channel. The USDA NRCS has taken the lead of these efforts and, thanks to the funds provided by NOAA trough HWG, PDC has partnered to implement hydroseeding to the restored riverbanks. A total estimated of 3 acres of bare soil were hydroseeded trough this partnership (Figures 3-5). The NRCS Southwest Conservation District (SWCD) served as another partner that collaborated by providing seeds of Bermuda grass as part of the in-kind/match and provided all the labor costs for the soil preparation. Collaboration from the local farmers helped with the fixation of the mulch to the soils as they provided water for irrigation for hydroseeding application and for irrigation.





Figure 2. Maria Antonia Farm, Rio Loco before hydroseeding application process.



Figure 3. Hydroseeding application process at Maria Antonia Farm, Rio Loco.



Figure 4. Rain event after Hydroseeding application at Maria Antonia Farm, Rio Loco.



Figure 5. Completed Hydroseeding technique at Maria Antonia Farm, Rio Loco.

### 3.2 Developing Yauco Coffee Farm

A second farm, located within the heart of the highly productive Yauco coffee farming area, was chosen to serve as a demonstration farm for other local farmers. Most farmers of the area seemed hesitant at first and preferred to see these techniques in action before committing to the restoration of their own farms. This farm was chosen for its prime location and the farm owners' disposition to work with the hydroseeding technique. A total area of approximately of 1.5 acres was addressed as it suffered serious erosion problems due to the slope angle of the eroded lands (Figures 6-9). Since implementing the hydroseeding technique at this farm, several other area farmers have approached PDC interested in applying this technique at their Yauco farms. In the case of this farm, the owners provided all the water for preparing the hydroseeding mixture and for further irrigation, as well as all the labor for the soil preparation.





Figure 6. Lands before hydroseeding process at the Yauco Developing Farm





Figure 7. Hydroseeding process at the Yauco Developing Farm



Figure 8. Lands after hydroseeding process at the Yauco Developing Farm



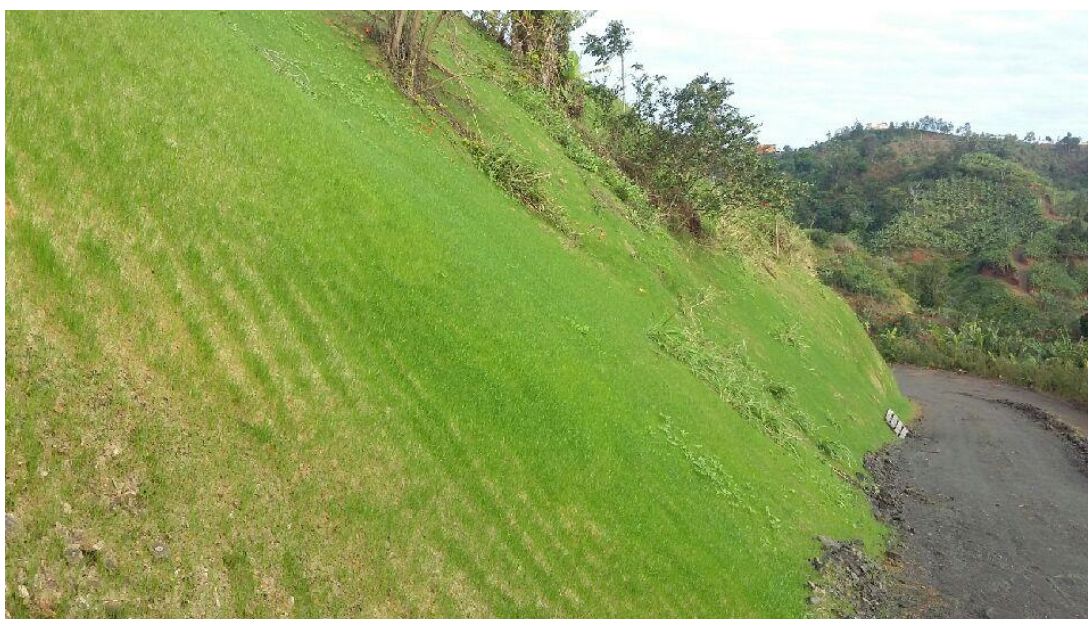


Figure 9. Lands after hysroseeding process at the Yauco Developing Farm

## 4 HYDROSEEDING TECHNIQUE SUCCESS

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Stabilization occurs best immediately after disturbance, longer time frames between clearing and stabilization results in a less favorable substrate. Often good soil for germination and growing can be washed away prior to hydroseeding efforts. Despite this, we are able to achieve >90% vegetative cover in the majority of sites stabilized by hydroseeding. It is important to point out that the soil has to be dry for the hydroseeding mixtures to bond correctly to the exposed soils. Hydroseeding mixture should be sprayed to the slopes from the bottom up for it to bond properly. The installation of two pumps in the water truck allows us to cut our watering time in half and allow for extra watering. In addition to using rye and Bermuda grass, it is possible to incorporate native tree and shrub species into hydroseeding mixtures. Most native species seeds are collected by local biologists and community volunteers. Maintenance and watering of the sites was provided for over 1 month to ensure project success.

## 5 COSTS

The work for stabilizing highly erodible sites in the Guánica Watershed projects was performed for a total cost of **\$38,115** as described in Table 1. From the total cost, approximately \$21,800 was used for the Maria Antonia site and \$16,315 for the Coffee Farm site. A total in-kind (non-cash) match of \$35,175 was estimated on this effort from contributing entities including the SWCD, local farmers and PDC as described in Table 2 for a total cost effort of \$73,290.

Table 1. Summarized Global Costs

CATEGORY	COST
Labor and Manpower	\$ 4,500
Rental Equipment and Materials Transportation	\$11,250
Materials (costs include Hydroseeding Supplies (mulch, fertilizer, polymers and seeds), and other mis. materials)	\$12,000
Project Management and Coordination	\$ 8,700
Travel (gas, etc.)	\$1,665
TOTAL \$ 38,115	

Table 2. Estimated In-Kind Match Contributions from Project Partners

ENTITY	ACTIVITY	UNITS	COST/UNIT	TOTAL COST
SWCD	3-50lbs of Bermuda Seeds	3	\$ 375	\$ 1,125
SWCD	30 days of labor for soil preparation	30	\$ 475	\$ 14,250
Farm owner Luis Ramos	80-2,500 g water tanks	80	\$ 75	\$ 6,000
Farm owner Luis Ramos	3 days of labor for soil preparation	3	\$ 475	\$ 1,425
Farmers from Maria Antonia	45-2,500 g water tanks	45	\$ 75	\$ 3,375
PDC	5 days Hydromulcher rental	5	\$ 600	\$ 3,000
PDC	32 Uncompensated hours	32	\$ 100	\$ 3,200
PDC	Water Truck	8	\$ 350	\$ 2,800
<b>TOTAL ESTIMATED</b>				<b>\$ 35,175</b>